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TECH 4398

Appendix I: Senior Design Project Abstract

Improvement of Semi-Automated Micro-Drilling System

Product Description:

1) Implementation of artificial intelligence (AI) for hands-free operation of a drilling system using Amazon's Alexa

2) Pattern recognition for a drilling system using image analysis

Abstract:

A semi-automated micro-drilling system was created by a Senior Design group in Spring 2018 and was operable. The Fall 2018 Senior Design class was tasked with improving it and they built an entirely new, more sophisticated version. The 2.0 design is a good foundation, but there are many improvements that should be made. The drill is controlled by programs written on Arduino which uses a coding language very similar to C++. Currently, it can be operated with heavy limitations by voice control through Alexa or by manually entering commands in the program. The operating procedure of the system when manually entering coordinates is:

1. X- and Y-axis coordinates are entered in the program
2. The drill goes to the specified coordinates
3. The drill turns on and drills to a previously specified depth (Z-axis)
4. The drill returns to the starting position (home position)
5. The program waits for another set of coordinates to be entered

The coordinate system is in millimeters. So, if you wanted to drill a hole in the center of a sample, you would measure the length and width of the sample in mm and dividing these dimensions in half would give you the coordinates of the center of the sample.

Customer needs:

1. The most important thing that needs to be improved is the overall stability and alignment of the system. If complete stability and near perfect alignment cannot be achieved, the precision and accuracy of the holes drilled will suffer drastically. The most obvious culprit of instability is a spacer that is the wrong size and cannot be fully secured. The fixture in which a sample is secured for operation should also be improved upon. Many more mechanical improvements can be determined through careful inspection of the system.

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2. Another request is to achieve the capability of complete and reliable operation through voice control instead of manually entering coordinates into the program. This can be done with the use of Amazon's Alexa. Limited operation by Alexa is already possible, but the program needs to be expanded and improved.

3. A third possible modification is to fully automate the system using a camera and image processing. The idea is to simply activate the program and an image is taken of the sample, certain features needing through-holes are identified, the coordinates of those features are determined, and the drill then goes to each position and drills a hole.
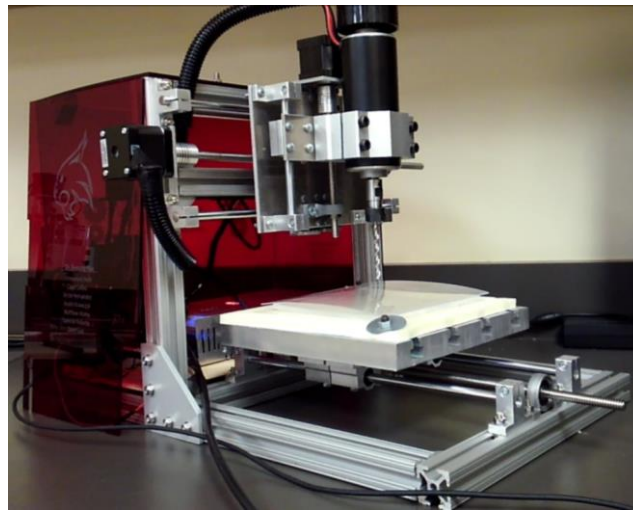
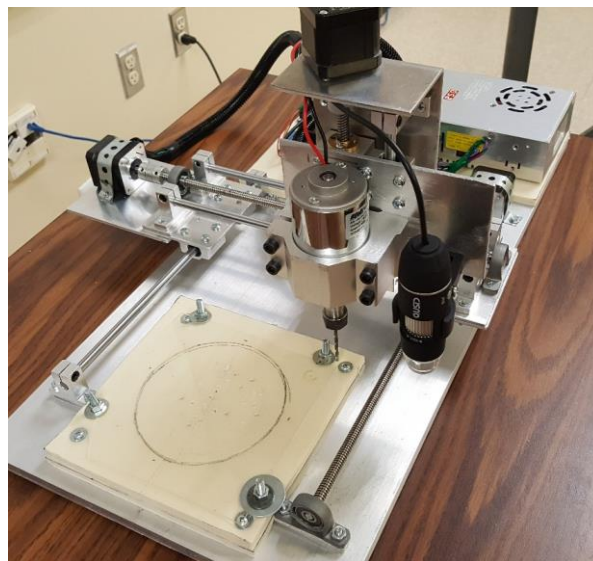

Figure 1 - Improved version of drilling system

Figure 2 - Initial fabrication of drilling system

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